A Comparison Study on the Effect of Using Traditional Boron and Nanotechnology Boron on Fruiting Of Early Sweet Grapevines

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Abstract: This study was conducted during 2016 and 2017 seasons for examining the effect of spraying boron applied via nano- technology at 0.0125 to 0.05 % as well as through traditional methods namely borax or boric acid each at 0.025 to 0.1 % on fruiting of Early sweet grapevines grown under Minia region conditions. The undertaken vines received three sprays of boron at growth start, just after berry setting and at veraison stage. Treating Early sweet grapevines three times with boron via nano- technology system at 0.0125 to 0.05 % or through conventional methods namely borax or boric acid each at 0.025 to 0.1% had a striking promotion on all growth aspects, photosynthetic pigments, N, P, K, Mg, yield, weight and compactness of cluster and both physical and chemical characteristics of the berries over the control. Using boron through nano technology system was materially superior than using it via traditional methods in this respect. Using boric acid was favourable than using borax in this connection. Meaningless promotion on the investigated parameters were recorded among the higher two concentrations of borax and boric acid namely 0.05 and 0.1% and nano – boron from 0.025 to 0.05%. Carrying out three sprays of nano boron at 0.025 % gave the best results with regard to yield and quality of early sweet grapevines grown under Minia region conditions.

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1. Introduction

Poor yield of Early sweet grapevine cv. grown under Middle Egypt conditions is considered to be a serious and major problem that faces grapevines growers. Therefore, for solving this problem, many attempts were accomplished for finding out the best horticultural practices. Boron fertilization is suggested to be very essential in promoting the yield of grapevines especially when applied at the appropriate concentration, frequencies, dates and methods of application. Nowadays, several authors pointed out that using nano- boron materially was preferable than using via traditional methods in stimulating the efficiency of uptake and quick curing of B deficiency.

The potential of nanotechnology to revolutionize the health care textile, materials, information and communication technology and energy sectors has been published. The application of nanotechnology agriculture is also getting attention nowadays. Investment in agriculture and food nano technology carrying promotion on the fruit crops because their potential benefits range from improving food quality and safety to the reduction in agricultural inputs and improved processing and nutrition (**Rai *et al.,* 2012 and Prasad *et al.*, 2014**).

Boron foliar spraying was found to be an effective method to increase boron level in reproductive and vegetative tissues rapidly. Applying boron must be done carefully because the available range between deficiency and toxicity is narrow (**Peacock and Christensen, 2005**). Reproductive tissues of grapevines are the most sensitive parts to boron deficiency, which lead o reduce fruit set and causing negative effects on fruit quality and fruit yield. In addition, the over dose of boron can lead to plant phytotoxicity (**Christensen and Smart, 2005**).

Boron is essential micronutrient for all plants. It is important to be available for the new reproductive development tissues and vegetative growth. Deficiency of boron in grapevines has many symptoms include disorders incidence, dieback of the shoot tip, yellow parts of the vines and poor set (**Marshner, 1995**). During flowering time, boron deficiencies can result in poor set, since it plays a main role in early season shoot growth and pollen growth and be generation which is needed for fertilization process and berry set (**Marshner, 1995 and Mengel *et al.,* 2010**). Vines that suffer from boron deficiency will have clusters that set low number of berries and low boron supply inhibit flowering and seed development (**Peacock and Christensen, 2005**). Generally, boron foliar application timing was found to affect fruit set, fruit quality and fruit development in many fruit trees.

Previous studies supported the beneficial effects of using boron via chelated or sulphate form on growth, yield and fruit quality in different grapevine cvs (**Abd El- Haffez, 2006; Amin, 2007; Ahmed, *et al.,* 2007; Abd El- Gaber- Nermean, 2009); El- Sawy, 2009; Abd El- Wahab, 2010; El-Kady-Hanaa, 2011; Abdelaal, 2012; Mohamed-Ebtesam, 2012; Nikkah *et al.,* 2013 and Mohamed, 2014**).

Foliar application of boron via nano form was very effective in enhancing growth, yield and nutritional status of fruit crops. Fruit quality in response to application of boron via nano technology was greatly improved (**Jinghuo, 2004; Liu *et al.,* 2006, Al- Amin Sadek and Jayasuriya, 2007; Derosa *et al.*,2010; Sabir *et al.,* 2014, Refaai, 2014; Mukhapadhyay, 2014; Cicek and Nadaroglu, 2015; Roshdy and Refaai, 2016; Manjunatha *et al.,* 2016; Wassel *et al.,* 2017; El- Sayed, *et al.,* 2017; Khalil, 2017; Abdalla, 2018; Ahmed *et al.,* 2018; Mohamed, 2018; Saied, 2018, El- Sayed Esraa, 2018 and Hussein and Abd El-all, 2018**).

The goal of this study was examining the effect of spraying normal boron versus nano technology on growth, vine nutritional status, yield and berries quality of Early sweet grapevines grown under Minia region conditions.

2. Materials and methods

This study was carried out during the two consecutive seasons of 2016 and 2017 on 60 uniform in vigour (10 years old Early Sweet grafted on harmony grape rootstock grown in a private vineyard located at West Matay, Matay district, Minia Governorate, where the soil texture is sandy and well drained water since water table depth is not less than two meters. The chosen vines are planted at 2 x 3 meters apart. Spur pruning system was followed at the first week of Jan. during both seasons leaving 66 eyes per vine (on the basis of 16 fruiting spurs x 3 eyes plus six replacement spurs x two eyes). The vines were irrigated through drip irrigation system.

Except those dealing with the present treatments (application of boron), all the selected vines (vines) received the usual horticultural practices that are commonly applied in the vineyard including the application of 10 tons F.Y.M. and 120 kg ammonium nitrate, 50 kg potassium, sulphate (48 % K_2O).25 kg magnesium sulphate (9.6 % Mg) as well as chelated Zn (21% Zn) and Mn (13% Mn) each at 25 kg and 2 kg chelated Fe (4.6 % Fe) per one fed. annually for both seasons. All macro and micro nutrient fertilizers were added via fertigation. F.Y.M. was added once just after winter pruning (3^{rd} week of January). Another horticultural practices such as twice hoeings, irrigation, pinching and pest management were carried out as usual.

Soil is classified as sandy in texture. The results of orchard soil analysis according to **Wilde *et al.,* (1985)** are given in Table (1)

This study included the following ten treatments:

1- Control.
2- Borax at 0.025%.
3- Borax at 0.05 %
4- Borax at 0.1 %
5- Boric acid at 0.25%
6- Boric acid at 0.5 %
7- Boric acid at 0.1 %
8- Nano boron at 0.0125%
9- Nano boron at 0.025%
10- Nano boron at 0.05%

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil:

Parameters	Values
Particle size distribution	
Sand %	76.2
Silt %	13.8
Clay %	10.0
Texture grade	Sandy
pH (1:2.5 extract)	8.00
E.C. (1: 2.5 extract) (mmhos/ 1cm/ 25^{o}C)	1.22
O.M. %	0.25
CaCO%	2.89
Macronutrients values	
Total N%	0.009
P (olsen method, ppm)	1.1
K (ammonium acetate, ppm)	119.0
Mg (ppm)	4.0
S (ppm)	1.1
B (hot water extractable) (ppm)	0.15
EDTA extractable micronutrients (ppm)	
Zn	1.31
Fe	1.09
Mn	1.10
Cu	0.29

Each treatment was replicated three times, two vines per each. The three boron sources namely borax (17 % B), boric acid (17% B) and pure nano boron (100 % B) were sprayed three times at growth start (1^{st} week of Mar.); just after berry setting (middle of April) and before veraison (3^{rd} week of May). Triton B as a wetting agent was added to all boron solutions and spraying was done till runoff.

A randomized complete block design (RCBD) was followed where this experiment included ten treatments each replicated three time two vines per each.

At the last week of May during both seasons, twenty mature leaves from the opposite side to the basal clusters on the shoots were picked for calculating the leaf area using the following equation outlined by **Ahmed and Morsy (1999)**

Leaf area (cm^2) = 0.45 (0.79 x diameter ^{2}) + 17.77.

The average leaf area was recorded. Average main shoot length (cm) was recorded as a result of measuring the length of ten shoots per vine (cm) and the average shoot length was recorded. Number of leaves per shoot was also recorded Dynamic of wood ripening coefficient was calculated by dividing the length of the ripened part of shoot that had brownished colour by the total length of the shoots (green colour) in the ten shoots/ vine (middle of Oct.) according to **Bouard (1966)**. Weight of pruning (kg.) / vine was recorded just after carrying out pruning by weighing the removal one year old wood (1st week of Jan.). Average cane thickness (cm) was estimated in the five basal internodes of ten canes per vine by using a Vernier caliper.

Fresh leaves of each vine were cut into small pieces and a known sample (0.5 g) from each sample was taken, homogenized and extracted using 25% acetone with the assistance of little amounts of Na_2CO_3 and clean sand. Filtration was washed several times with acetone till the filtrate was colorless. Acetone was used as a blank. In the filtrates, the optical density was determined using spectrophotometer at the leave length of 662 and 644 mm to determine chlorophylls a and b, respectively. The following equations were used for determination of these plant pigments according to **Von- Wettstein (1975)**

Ck.1= (9.784- E 622) – 0.99 - E 644) = mg/1

Ch.b = (21.246- E 644) – (4.65- E 662) + mg/l

Total chl.= ch.A + Ch.B

where E= optical density at a given wave length. Calculations were estimated as mg/ 100 g F.W.

Petioles of the same leaves that were taken for measuring the leaf area according to **Balo *et al.*, (1988)** were washed several times with water and distilled water and then oven dried at 70^{o}C and grounded, then 0.5 g weight of each sample was digested using H_2SO_4 and H_2O_2 until clear solution (**Chapman and Pratt, 1965**). In the digesterd solutions, the following nutrients were determined:

1- N % by the modified micro Kejdahl method as described by (**Peach and Tracey, 1968**)

2- P % by using Olsen method as reported by **Wilde *et al.*, (1985)**.

3- K % by using flame photometer as outlined by (**Wilde *et al.*, 1985**).

4- Mg as ppm by titration against EDTA (versene method) (**Peach and Tracey, 1968**).

When T.S.S./ acid in the control treatment reached 25:1, clusters were harvested of (2nd week of June). The yield of each vine was recorded in terms of weight (kg.) and number of clusters/ vine. Five clusters per each vines were taken for determination of the following physical and chemical characteristics of the berries.

1- Average cluster weight (g.) and average cluster compactness (number of berries / cluster length)

2- Percentage of shot berries by dividing number of small berries by total number of berries and multiplying the product by 100.

3- Average berry weight (g.) and dimensions (longitudinal and equatorial (in cm)

4- Percentage of total soluble solids in the juice by using handy refractometer.

5- Percentage of total acidity in the juice (as a tartaric acid/ 100 ml juice) by titration against 0.1 N NaOH using phenolphthalein indicator (**A.O.A.C., 2000**).

6- The ratio between T.S.S. and acid.

7- The percentage of reducing sugars in the juice (**Lane and Eynon, 1965**) as described by **A.O.A.C. (2000)**.

Statistical analysis was done and the different treatment means were compared using new L.S.D. at 5% (**Snedecor and Cochran, 1980 and Steel and Torrie, 1980**).

3. Results and discussion

1-Vegetative growth aspects:

It is clear from the data in Table (2) that treating Early Sweet grapevines three times with boron in the three sources namely borax and boric acid each at 0.025 to 0.1% and nano- boron at 0.0125 to 0.05% caused significant stimulation on the length of main shoots; number of leaves per shoot, leaf area, wood ripening coefficient, cane thickness and pruning wood weight relative to the control. The best sources of boron in enhancing these growth aspects was borax, boric acid and nano – boron, in ascending order. There was a gradual promotion on these growth aspects with increasing concentrations of borax and boric acid from 0.025 to 0.1% and nano- boron from 0.0125 to 0.05%. Increasing concentrations of borax and boric acid from 0.05 to 0.1% and nano boron from 0.025 to 0.05% had no significant promotion on the six growth traits. The maximum values of shoot length (120.3 & 121.0 cm), number of leaves (28.0 & 28.0 leaf)), leaf area (119.3 & 11.0 cm^2), wood ripening coefficient (0.95

& 0.96 cm), cane thickness (1.58 & 1.59 cm) and pruning wood weight (2.68 & 2.77 kg/ vine) were recorded on the vines that sprayed with boron in the form of nano- boron at 0.05 % during both seasons, respectively. The minimum values were observed on untreated vines. These results were true during both seasons.

Table (2): Effect of spraying borax, boric acid and nano boron on some vegetative growth characteristics of Early Sweet grapevines during 2016 and 2017 seasons.

Treatments	Main shoot length (cm)		Number of leaves / shoot		Leaf area (cm^2)		Wood ripening area (cm^2)		Cane thickness (cm)		Pruning wood weight / vine (kg)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	106.3	105.9	15.0	14.0	108.1	107.9	0.64	0.63	1.00	1.04	1.81	1.91
Borax at 0.025 %	108.0	108.3	17.0	16.0	109.6	110.0	0.70	0.69	1.10	1.15	1.96	2.06
Borax at 0.05 %	110.0	110.6	19.0	18.0	111.0	111.6	0.76	0.75	1.20	1.25	2.11	2.21
Borax at 0.1 %	110.3	111.0	19.0	19.0	111.3	112.0	0.77	0.76	1.21	1.25	2.16	2.26
Boric acid at 0.025 %	112.3	112.6	21.0	21.0	113.0	113.9	0.83	0.82	1.30	1.33	2.27	2.37
Boric acid at 0.05 %	114.6	115.0	23.0	23.0	114.6	115.9	0.88	0.87	1.41	1.41	2.41	2.51
Boric acid at 0.1%	115.0	115.3	24.0	23.0	115.0	116.0	0.88	0.88	1.41	1.42	2.42	2.51
Nano-boron at 0.0125 %	118.0	118.6	26.0	25.0	117.0	117.6	0.93	0.92	1.50	1.49	2.55	2.64
Nano-boron at 0.025 %	120.0	120.6	28.0	28.0	119.3	118.9	0.95	0.96	1.57	1.58	2.67	2.76
Nano-boron at 0.05 %	120.3	121.0	28.0	28.0	119.0	119.0	0.95	0.96	1.58	1.59	2.68	2.77
New L.S.D. at 5%	1.1	0.9	2.0	2.0	1.1	1.2	0.05	0.04	0.06	0.07	0.11	0.12

Table (3): Effect of spraying borax, boric acid and nano boron on some photosynthetic pigments and percentages of N, P, K and Mg in the leaves of Early Sweet grapevines during 2016 and 2017 seasons.

Treatments	Chlorophyll a (mg/ g F.W.)		Chlorophyll b (mg/ g F.W.)		Total chlorophylls (mg/ g F.W.)		Leaf N %		Leaf P %		Leaf K %		Leaf Mg %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	4.1	3.9	1.1	1.1	5.2	5.0	1.55	1.49	0.161	0.171	1.11	1.09	0.56	0.59
Borax at 0.025 %	4.6	4.7	1.4	1.6	6.0	6.3	1.63	1.65	0.176	0.191	1.17	1.15	0.61	0.65
Borax at 0.05 %	5.0	5.1	1.7	2.1	6.7	7.0	1.71	1.73	0.191	0.211	1.23	1.21	0.66	0.70
Borax at 0.1 %	5.1	5.1	1.8	2.2	6.9	7.3	1.72	1.75	0.192	0.212	1.24	1.22	0.67	0.71
Boric acid at 0.025 %	6.0	6.1	2.5	2.5	8.5	8.6	1.82	1.85	0.211	0.224	1.29	1.30	0.72	0.77
Boric acid at 0.05 %	6.5	6.7	2.8	2.8	9.3	9.5	1.92	1.95	0.225	0.239	1.34	1.36	0.76	0.82
Boric acid at 0.1%	6.6	6.8	2.9	2.9	9.5	9.7	1.93	1.96	0.226	0.241	1.35	1.36	0.77	0.82
Nano-boron at 0.0125 %	7.1	7.5	3.2	3.3	10.3	10.8	2.00	2.04	0.241	0.255	1.41	1.42	0.82	0.87
Nano-boron at 0.025 %	7.5	8.0	3.5	3.6	11.0	11.6	2.06	2.11	0.261	0.270	1.46	1.49	0.87	0.92
Nano-boron at 0.05 %	7.5	8.1	3.6	3.6	11.1	11.7	2.07	2.12	0.262	0.271	1.47	1.50	0.88	0.93
New L.S.D. at 5%	0.3	0.4	0.2	0.3	0.4	0.5	0.06	0.05	0.011	0.012	0.04	0.05	0.04	0.05

Table (4): Effect of spraying borax, boric acid and nano boron on the yield, weight and compactness of cluster and berry weight and longitudinal of Early Sweet grapevines during 2016 and 2017 seasons.

Treatments	No. of clusters / vine		Yield/ vine		Av. Cluster weight		Av. Cluster compaction		Av. Berry weight (g.)		Av. Berry longitudinal (cm.)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	24.0	22.0	10.3	9.4	43.0	429	3.95	3.86	3.55	3.56	2.01	2.02
Borax at 0.025 %	24.0	24.0	10.6	10.6	441	442	4.03	3.96	3.62	3.64	2.05	2.07
Borax at 0.05 %	24.0	26.0	10.9	11.8	453	455	4.12	4.06	3.72	3.73	2.10	2.12
Borax at 0.1 %	24.0	26.0	10.9	11.8	454	455	4.13	4.12	373	374	2.11	2.13
Boric acid at 0.025 %	24.0	28.0	11.2	13.0	465	466	4.22	4.22	3.81	3.83	2.16	2.18
Boric acid at 0.05 %	24.0	30.0	11.5	14.3	480	477	4.31	4.32	3.91	3.94	2.21	2.22
Boric acid at 0.1%	24.0	30.0	11.5	14.3	481	478	4.32	4.33	3.92	3.95	2.22	2.22
Nano-boron at 0.0125 %	25.0	32.0	12.4	15.7	494	491	4.49	4.51	4.06	4.10	2.26	2.27
Nano-boron at 0.025 %	25.0	34.0	12.6	16.8	505	494	4.60	4.64	4.26	4.30	2.36	2.37
Nano-boron at 0.05 %	25.0	34.0	12.7	16.8	506	495	4.61	4.65	4.29	4.31	2.37	2.38
New L.S.D. at 5%	NS	2.0	0.3	0.7	10.1	10.4	0.06	0.07	0.05	0.04	0.03	0.04

Table (5): Effect of spraying borax, boric acid and nano boron on some physical and chemical characteristics of the berries of Early Sweet grapevines during 2016 and 2017 seasons.

Treatments	Av. Berry equatorial		Reducing sugars %		T.S.S.%		Total acidity %		T.S.S./ acid	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	1.88	1.89	17.2	17.0	14.9	15.0	0.677	0.674	25.4	25.2
Borax at 0.025 %	1.92	1.92	17.6	17.5	15.5	15.6	0.662	0.660	26.6	26.5
Borax at 0.05 %	1.96	1.97	18.1	18.1	16.0	16.0	0.648	0.646	27.9	28.0
Borax at 0.1 %	1.97	1.98	18.2	18.2	16.1	16.0	0.647	0.645	28.3	28.2
Boric acid at 0.025 %	2.04	2.06	18.6	18.8	16.6	16.8	0.630	0.628	29.5	29.9
Boric acid at 0.05 %	2.08	2.10	19.0	19.3	17.1	17.1	0.600	0.598	31.7	32.3
Boric acid at 0.1%	2.09	2.11	19.0	19.4	17.1	17.2	0.599	0.597	31.7	32.5
Nano-boron at 0.0125 %	2.013	2.16	19.5	19.8	17.5	17.6	0.580	0.578	33.6	34.3
Nano-boron at 0.025 %	2.17	2.19	20.1	20.3	18.1	18.2	0.560	0.558	35.9	36.4
Nano-boron at 0.05 %	2.18	2.20	20.2	20.3	18.2	18.3	0.559	0.557	36.1	36.4
New L.S.D. at 5%	0.03	0.03	0.3	0.3	0.3	0.3	0.011	0.014	0.8	0.9

2- Leaf components:

Data in Table (3) indicate that chlorophylls a & b, total chlorophylls and percentages of N, P, K and Mg were significantly improved in response to subjecting the vines with boron via all sources compared to the check treatment. The promotion was significantly related to using boron sources namely nano- boron, boric acid and borax, in descending order. Using nano- boron method was significantly superior than using the two traditional methods namely borax and boric acid. There was a progressive promotion on these chemical component with increasing concentrations of borax, boric acid and nano- boron. The maximum values of chlorophylls a & b, total chlorophyll, N, P, K and Mg were noticed on the vines that received nano- boron at 0.05%. The untreated vines produced the minimum values. Similar results were noticed during 2016 and 2017 seasons.

3- Yield/ vine:

As shown in Table (4) yield per vine expressed in number of clusters per vine and weight of clusters (kg.) was significantly improved in response to using boron via traditional methods (borax or boric acid) and via nano- technology than the control treatment. Using boron through nano- technology was significantly superior than using boron via conventional methods namely borax and boric acid in promoting the yield. Yield was gradually increased with increasing concentrations of borax, boric acid and nano boron. Increasing concentrations of borax and boric acid from 0.05 to 0.1 % and nano boron from 0.025 to 0.05% had meaningless promotion on the yield. Therefore, from economical point of view, it is suggested to use the medium concentration of nano boron namely 0.025 % for gaining the maximum yield that reached 12.7 & 16.8 kg during both seasons respectively compared with the yield of the control vines that reached 10.3 & 9.4 kg during 2016 and 2017 seasons, respectively. The percentage of increment on the yield due to using the previous promised treatment (using nano boron at 0.025%) over the control treatment reached 23.3 and 78.7 during 2016 and 2017 seasons, respectively. Number of clusters /vine in the first season of study was unsignificantly affected by the present traditional and nano technology uses of boron. These results were true during both seasons.

4- Weight and compactness of cluster:

It is evident from the data in Table (4) that subjecting the vines with boron via borax and boric acid at 0.025 to 0.1% as well as via nano- boron at 0.025 to 0.5% had significant promotion on the weight and compactness of cluster over the control. The promotion was associated with increasing concentration of borax, boric acid and nano boron. Nano – technology use of boron at 0.0125 to 0.05% had supreme effect on such two parameters compared to the use of conventional methods of boron namely borax and boric acid. The superiorly of boron methods on improving cluster weight and compactness was arranged as following in ascending order, borax, boric acid and nano boron. No significant promotion on such two cluster parameters was noticed among the higher two concentrations of borax and boric acid (0.05 & 0.1%) and nano boron (0.025 and 0.05%). The maximum values of cluster weight (506 & 495 g) and compactness s (4.65 & 4.27) were recorded on the vines that sprayed three times with nano boron at 0.05 %. The lowest values were recorded on the untreated vines. Similar trend was noticed during 2016 and 2017 seasons.

5- Physical and chemical characteristics of the berries

It is worth to mention from the data in Tables (4 & 5) that subjecting Early Sweet grapevines with boron via traditional method (borax or boric acid at 0.025 to 0.1%) or nano- technology (nano- boron at 0.0125 to 0.5 % resulted in significant promotion on both physical and chemical characteristics of the berries rather than the check treatment. This promotion appeared in increasing berry weight and dimensions (longitudinal and equatorial), T.S.S. %, reducing sugars % and T.S.S. /acid and decreasing total acidity %. Using boron via nano technology was significantly preferable than using it via traditional methods namely borax and boric acid in enhancing berries quality. Using boric acid was significantly superior than using borax in this respect. The promotion on berries quality was in proportional to increasing concentrations of borax, boric acid and nano boron. Meaningless promotion on quality of the berries was noticed among the higher two concentrations of each boron materials. The best results were obtained due to using nano boron at 0.025 %. These results were true during both seasons

4. Discussion

The beneficial effects of boron on stimulating vegetative growth characteristics, chlorophylls, nutrients, yield and quality of the berries in grapevines cv. Early Sweet might be attributed to its impact on (according to **Mengel *et al.,* 2010 and Passingham, 2004**).

1- Translocation and adsorption of sugars, since sugars may be moved in the form of borate complexes.

2- Activating the formation of meristems.

3- Preventing the abortion of flowers.

4- Preventing the accumulation of polyphenolic compounds.

5- Incouraging cell development and the elongation of cells through controlling of polysaccharide synthesis.

6- Controlling the formation of starch and preventing the excessive concersion of sugars into starch.

7- Incouraging root development.

8- Reducing at the lower extent the different disorders in the fruit crops.

These results regarding the promoting effect of boron on growth, vine nutritional status, yield and quality are in agreement with those obtained by **Abd El- Haffez (2007); Amin (2007); Ahmed *et al.,* (2007), El- Sawy (2009); El- Kady – Hanaa (2011); Abdelaal (2012) and Mohamed (2014)** who worked on normal boron and **Derosa *et al.,* (2010); Sabir *et al.,* (2014) Refaai (2014); Roshdy and Refaai (2016), Wassel *et al.,* (2017), El- Sayed *et al.,* (2017); Khalil (2017); Abdalal (2018); El- Sayed – Esraa (2018) and Saied (2018).**

Conclusion:

Treating Early sweet grapevines grown under Minia region conditions three times (growth start, just after berry setting and at veraison stage) with boron via nano- technology at 0.025 % was responsible for maximizing the yield and producing berries with better quality parameters.

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